

REMARKS

Status of Claims

Claims 18-34 are pending.

Claims 1-17 have been cancelled.

Claims 18-34 are new. Support for the new claims 19-33 is found in original claims 1-17.

Claim Rejections - 35 USC § 103(a)

In [5] of the Office Action, claims 1-17 were rejected under 35 U.S.C. 103(a) as being obvious over Banerjee et al, U.S. Patent No. 5,672,438.

Applicants have cancelled claims 1-17 and this rejection is believed to be obviated.

The Examiner states that it would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate a solid fluorinated polymer electrolyte membrane having an IXR of at least about 17 into the direct oxide fuel cell of Banerjee. The Examiner recognizes that Banerjee does not expressly teach that the IXR is from 17 to 29 or from 19 to 23, and thickness of the membrane is 250 μm . The Examiner further states that the solid polymer electrolyte membrane of the direct methanol fuel cell of Banerjee is structurally similar to that instantly disclosed, the fuel cell appears capable of being operated as claimed with similar if not identical claimed characteristics.

Applicant's new claims are directed to a method of increasing the power output in a direct methanol fuel cell comprising:

- (i) providing (a) a solid fluorinated polymer electrolyte membrane having an ion exchange ratio (IXR) of at least about 17, wherein the solid polymer electrolyte membrane has a first surface and a second surface; and (b) at least one catalyst layer present on each of the first and second surfaces of the solid polymer electrolyte membrane; and
- (ii) operating the direct methanol fuel cell at a temperature of less than 60 °C;

wherein the methanol cross-over rate is reduced by at least about 20 %;

wherein the power output is increased up to about 15% as compared to a fuel cell comprising a solid fluorinated polymer electrolyte membrane having an ion exchange ratio (IXR) of about 15 and the same thickness as the solid fluorinated polymer electrolyte membrane in (a).

As disclosed in Banerjee the efficiency of the fuel cell is increased by using membranes with high IXR, despite the decrease in ionic conductivity. See Col.3, lines 46-52.

‘It has been discovered that DMFC efficiency is significantly improved by using an ion exchange membrane comprising polymer having a high ratio of carbon atoms in the polymer backbone to cation exchange groups even though ionic conductivity decreases as this ratio increases. This ratio of carbon atoms in the polymer backbone to cation exchange groups is sometimes referred to herein after as “IXR”

Banerjee attributes the increase in efficiency to be independent of thickness for thin membranes having high IXR values. See Col.3, lines 52-58.

‘The increase in efficiency is a consequence of the surprising finding that, while methanol fuel crossover decreases with increasing IXR, crossover is essentially independent of thickness so that a thin membrane having high IXR can be used to achieve reduced methanol crossover without severe penalty to ionic conduction.’

Thin membranes having reduced methanol crossover as disclosed in Banerjee have an IXR of at least about 23. See Col.3, lines 62-63.

‘An IXR of at least about 23:1 is desired for the high-IXR membrane component.....’

Applicant submits that Banerjee does not appreciate the power density reduction at 60⁰C as observed by the Applicant. See the specification at page 14, lines 15-19 where it is stated that:

“The performance was recorded as detailed in the example 1, which is shown in Figure 4. Although the membrane (6mil, IXR = 23, 1500EW) reduces the methanol crossover compared to the Nafion® N117 membrane, it delivers poor power density as a result of higher membrane resistance at 60°C.”

In contrast, Applicant's fuel cell when operated at a temperature of less than 60 °C the methanol cross-over rate is reduced by at least about 20% and the power output is equal to or increased up to about 15%. This is in comparison to a solid fluorinated polymer electrolyte membrane having the same thickness, and an ion exchange ratio (IXR) of about 15. This is apparent in Figure 3 of the specification where the power density of the membrane with an IXR of 15 is equal to or increased up to about 15% than that of a membrane with an IXR of 23 when operated the fuel cell is operated at a temperature of 28°C.

In light of the above discussion, Applicants submit that Banerjee does not disclose or describe the claimed process.

In view of the foregoing, allowance of claims 18-24 of the above-referenced application is respectfully requested.

Respectfully submitted,

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